

CHAPTER 3

DAM FAILURES

Dams and reservoirs serve a very important role for Wyoming residents and industry. Rarely, however, the dams fail, either completely or partially, and become a significant hazard for those downstream. Dam failures result in a unique source of flash flooding, when a large amount of previously detained water is suddenly released into a previously dry area due to a failure in some way of the dam.

Dam failures can be grouped into four classifications: overtopping, foundation failure, structural failure, and other unforeseen failures. Overtopping failures result from the uncontrolled flow of water over, around, and adjacent to the dam. Earthen dams are most susceptible to this type of failure.

Dam failures can result from any one or a combination of the following causes:

- Prolonged periods of rainfall and flooding, which result in overtopping
- Earthquake
- Inadequate spillway capacity resulting in excess overtopping flows
- Internal erosion caused by embankment or foundation leakage or piping or rodent activity
- Deformation of the foundation or settling of the embankment
- Improper design
- Improper maintenance
- Negligent operation
- Failure of upstream dams on the same waterway

Overtopping failures account for approximately 28% of all dam failures. Structural failures account for approximately 28% of all dam failures, and foundation problems account for another 25%. Foundation and structural failures are usually tied to seepage through the foundation of the main structure of the dam. Earthquakes or sabotage account for 12% of all dam failures, while inadequate design and construction account for the remaining 7% of failures.

In 1981, the U.S. Army Corps of Engineers completed an inspection program for nonfederal dams under the National Dam Inspection Act (P.L. 92-367). This was a four-year work effort and included compiling an inventory of about 50,000 dams and conducting a review of each state's capabilities, practices, and regulations regarding design, construction, operation, and maintenance of dams. Part of the inspection included evaluating the dams and assigning a hazard potential based on the effects downstream should one of the dams fail.

Dams are classified based upon hazard potential. This classification is based on the consequences if a dam were to fail, not on the potential of failure or the existing condition of the dam. Dam classifications include: (1) high, (2) significant, and (3) low hazard. The Corps of Engineers based the hazard potential designation on such items as acre-feet capacity of the dam, distance from nearest community downstream, structures and population in the inundation zone, population density of the community, and age of the dam. High hazard dam failures would involve property losses over \$1 million and likely cause loss of life. Significant hazard dam failures would likely cause significant property damage but no loss of life. Failure of a low hazard dam would likely cause only minimal property damage and no loss of life. Hazard potential classification is no guarantee of safety. Hazard classifications can also change over time due to development within the inundation zone.

The Wyoming State Engineer's Office (WSEO) regulates dams over 20 feet high of with a storage capacity of 50 acre-feet or more, although smaller dams are also regulated if the potential for failure indicates a need. According to the WSEO website (<http://www.damsafety.org/map/state.aspx?s=51>, accessed October 10, 2012), as of 2011 the WSEO regulates 1,518 dams. As part of the regulatory process the WSEO inspects these dams once every five years. Of these dams, 81 are rated high hazard, 109 are rated significant hazard, and 1,328 are rated low hazard. Figure 3.1 shows the dams that are inspected by the Wyoming State Engineers Office. HAZUS has records of 68 dams in Crook County. One is classified as high hazard, and seven are classified as significant hazard. Table 3.1 summarizes the high and significant hazard dams located in Crook County.

Table 3.1 High and Significant Hazard Dams in Crook County						
Name	Owner	River	Hazard Class	Nearest Downstream City	Distance to Nearest Downstream City (miles)	EAP
Keyhole	DOI BR	Belle Fourche River	H	Hulett	28	Y
Cook Lake	Forest Service	Beaver Creek	S	Alva	10	Y
Foster Storage	Mr. Foster	Foster Creek	S	Camp Creek, SD	77	N
French	Rauth Ranches, Inc.	Morris Draw	S	Alva	1	N
Kruger Creek	T & J Jensen & Wyo. Board of Control	Kruger Creek	S	Belle Fourche, SD	20	N
Oak Creek	Thorval & Janet Jensen	Alum Creek or Oak Creek	S	Belle Fourche, SD	17	N
Tract 37	F.A. Bush & Wyo. Board of Control	North Fork Little Missouri River	S	Alzada, MT	0	N

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Name	Owner	River	Hazard Class	Nearest Downstream City	Distance to Nearest Downstream City (miles)	EAP
Washington Memorial	Crook County Commissioner	Sundance Creek	S	Sundance	0 (within city limits)	N

Source: HAZUS-MH 2.1, National Inventory of Dams (NID)

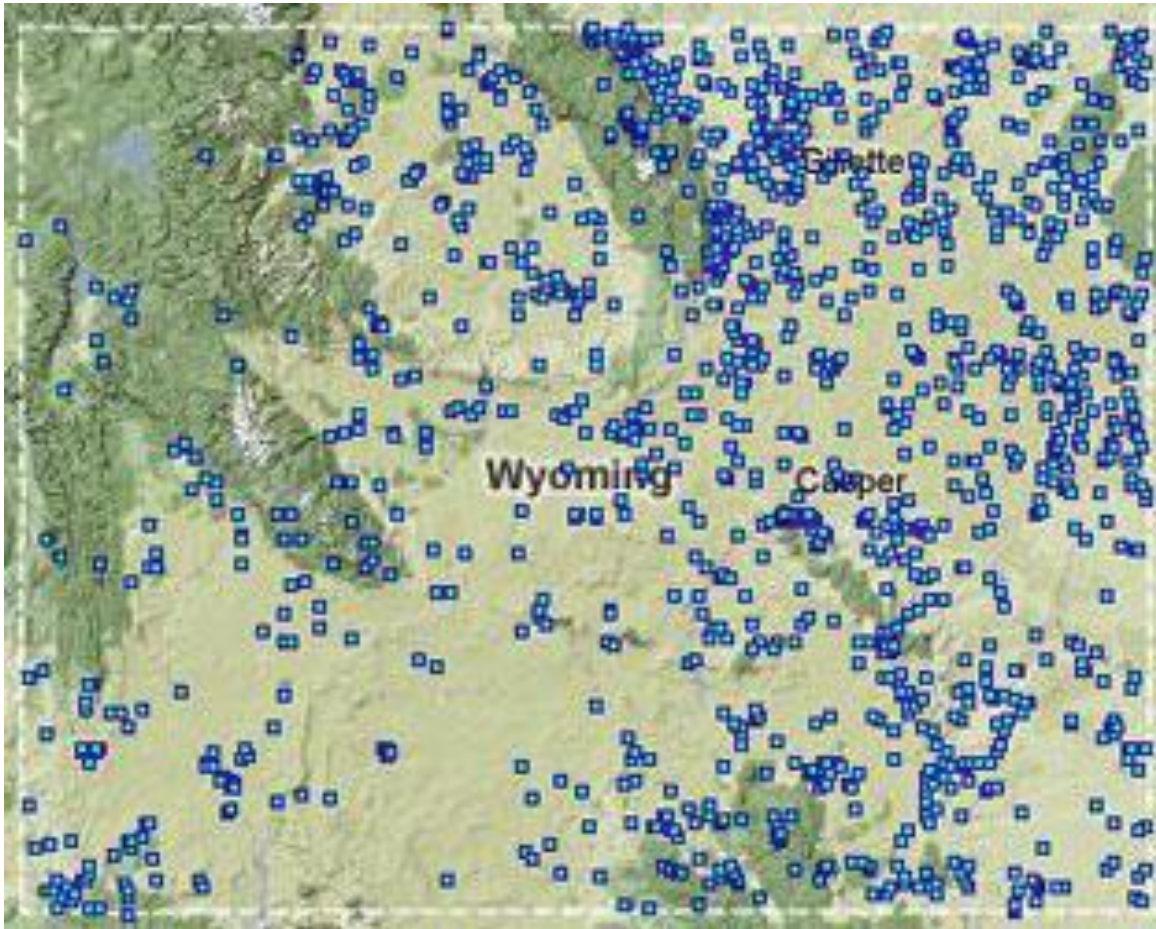


Figure 3.1 Dams Inspected by the Wyoming State Engineers Office and the U.S. Bureau of Reclamation (2010).

History

There have been a number of dam failures in Wyoming, some of which have caused the loss of life and damage to property. Some of the smaller dams in the County have experienced breaches or flooding in the past.

Impacts

No dam failure impacts have been documented in Crook County. Keyhole Reservoir is the largest dam in the county with a normal storage capacity of 193,753 acre feet. The Town of Hulett lies downstream of Keyhole Reservoir on the Belle Fourche River. Washington Memorial is a small reservoir within the city limits of Sundance. Based on HAZUS flood analysis, Sundance has the highest potential loss from flooding of any jurisdiction in Crook County. Hulett has the second highest potential loss from flooding. See *Chapter 7 Flood* for further details on potential loss from flooding in Crook County.

Future Impacts

With eight high or significant dams within the County there is a possibility of dam failure flooding in the future, with the potential for \$1 million or more in flood damages and loss of life. Development or future development along portions of Beaver Creek, Morris Draw, Foster Creek, Alum (or Oak) Creek, Belle Fourche River, North Fork of the Missouri River, Kruger Creek, and Sundance Creek could be at risk to dam failure flooding.

Two landslides areas in Crook County create additional potential for dam failure events. If a landslide mass descends into a river, stream, reservoir, etc., it can create a natural earthen dam. Water then builds up behind the mass until the dam is breached. This can result in flash flooding, threatening life safety and property downstream.

On the Kruger Lake Quadrangle there is a blockslide/slump/flow complex and a blockslide on the east side of Pine Creek Reservoir. If these areas destabilized, damage could occur to the reservoir and dam. Two blockslides on the Missouri Buttes Quadrangle exist on the north and south sides of Left Creek in T53N R66W Sections 21, 27, and 28. These blockslides could potentially dam Left Creek if they destabilized. A blockslide/rockslide/slump/flow complex is also present on the east side of Missouri Buttes Lake. If the landslide destabilizes, the lake could be severely damaged or destroyed. See *Chapter 10 Landslides* for further details on unstable slope areas that could cause dam failures.

The LEPC estimates that the probability of dam failure in Crook County is medium.

Summary

PROPERTY AFFECTED: Medium

POPULATION AFFECTED: Low

PROBABILITY: Medium

JURISDICTION AFFECTED: Portions of Unincorporated County, Hulett, and Sundance